Motivation for Planning for a C.R. Telescope for the GLAST LAT I&T

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This note is to motivate the planning for a muon cosmic ray (C.R.) telescope ("CRT") for the GLAST LAT integration and test (I&T).
It is organized in 3 parts
1) General properties of a CRT in support of the I&T function of the GLAST LAT
2) Potential role of a CRT in the I&T flow of the GLAST LAT
3) General statements about the advantages of a CRT during the I&T phase

1. General properties of a C.R. telescope (CRT) in support of the I&T function of the GLAST LAT

A CRT will define the particle content, the impact point and the direction of incoming C.R. muons.

It will consists of two finely subdivided multi-layer planes above and below the LAT towers, allowing the prediction of the particle location at any point in the LAT to a millimeter.
Using suitable subdivided absorbers below the telescope, the energy and particle content of the C.R. can be estimated. (one could imagine dialing in showering particles by selecting an anti-coincidence with the absorber layers.).
To be useful for the GLAST I&T, the CRT should cover a large area of the LAT such that multi-tower studies can be performed, i.e. should cover at least a 2x2 tower footprint (70 cm x 70 cm), preferentially more.
In addition, the planes should be movable to allow for angled incidence, and for installation of LAT towers.
An important requirement is that the DAQ system of the CRT be compatible with the GSE system of the LAT.

An CRT with many of these properties is being developed by SLAC Group B and is shown in Fig. 1. The dimension in one direction might be a bit small to cover a 2x2 tower set-up. The DAQ is VME based.

2. Potential role of a C.R. telescope in the I&T flow of the GLAST LAT

The CRT will mainly be used to ascertain the well-being of single towers before integration and the multi-tower functionality of the LAT after integration. Note that at least two subsystems (CAL and TKR) have been using CRTs in the checkout of the BTEM hardware and are planning to use them for the subsystem module checkout and calibration of flight hardware. It is unlikely that Science Requirements parameters will be measured, except for some basic understanding of the effective area (dead layers, dead chips etc, and trigger efficiency) and the dead time (see below).

Thus after arrival at SLAC, the subsystem modules would be inserted into the CRT and tested for about ½ day. This allows to accumulate about 100k clean triggers with which the functionality, alignment and calibration (efficiency, dead channels, noise rate in the TKR, dead channels and muon energy scale in the CAL) can be checked after transport.

The second function of the CRT will be to monitor the multi-tower functionality and triggering of the LAT during I&T. It will allow to test if the actual flight DAQ hardware and software is stable while additional towers are added and the C.R. events become more complex with events involving data from different towers (hence the need for angled tracks). In addition, the dead time and rate limitation can be simulated by triggering the LAT towers with calibration pulses, while being active for C.R. events at the same time. Since the C.R. events are cleanly tagged in the CRT, our ability to reconstruct them is a measure of the rate capability of the instrument.

3. General remarks about the advantages of a CRT during the I&T phase

The following are "Motherhood & Apple Pie Statements" about the advantage of a CRT.

?? C.R. muons can be used on all levels of sophistication from a simple, immediate and direct visual feed back on a CRT screen to a detailed analysis on the mm scale. I believe, that if needed, we could fly the instrument after a thorough C.R. test and a short two tower beam test.

?? C.R. muons support any I&T schedule faithfully: they do not have to be scheduled, are always the "main user", can't be "browned-out", don't break down, need very little DAQ to tag.

?? C.R. muons arrive in a stochastic manner from almost all angles. Without the muon absorber planes in the trigger, the rate can be quite high (~ kHz ?).

?? A CRT can be installed in the clean room.

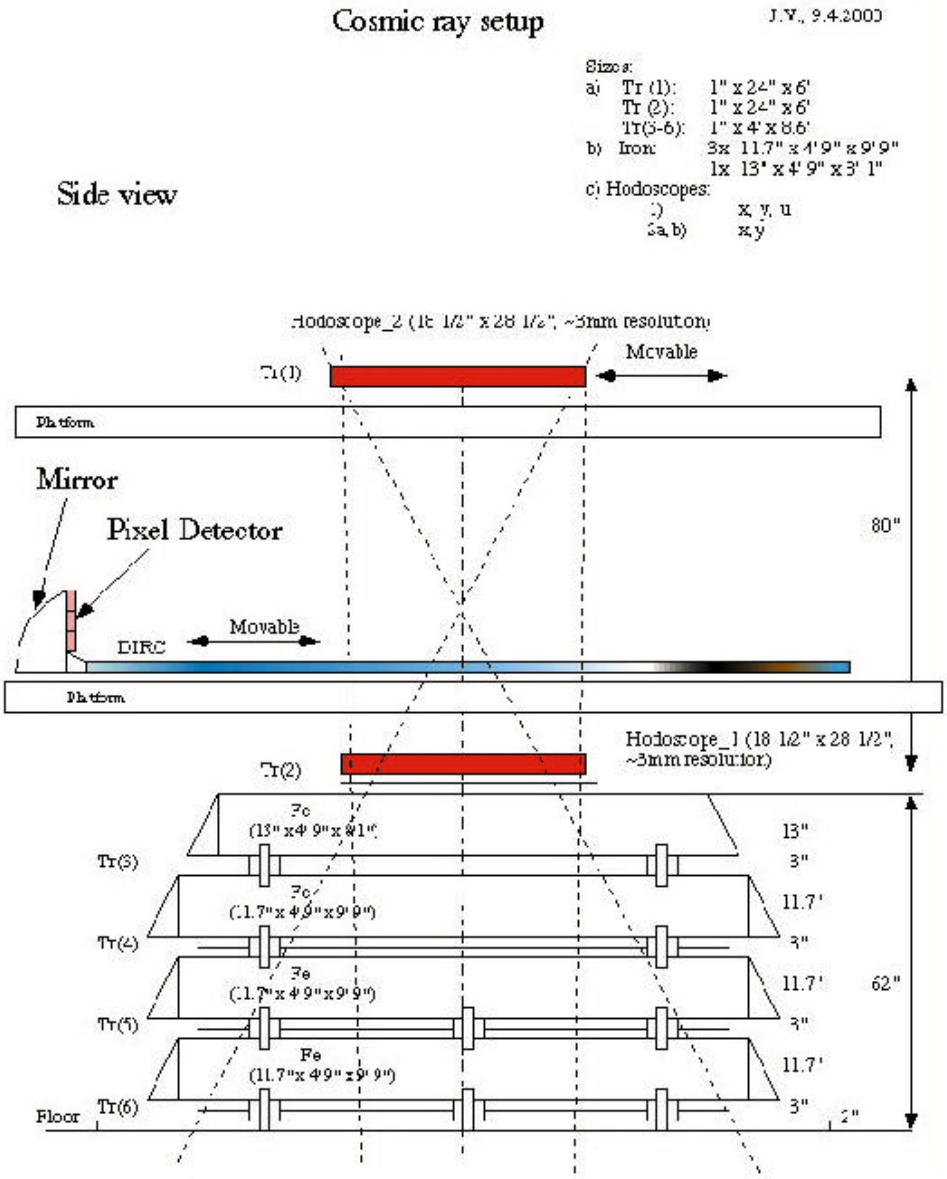

Fig. 1 C.R. Telescope under construction by SLAC Group B in the SLAC Research Yard. (Courtesy Jaroslav Va'vra)